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ORIGINAL RESEARCH

Assessment of gestational age by new Ballard's score and its correlation with foot length

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ABSTRACT

Background: Neonatal death is one of the major contributors (50%) of Under-five child mortality and 70% of the infant mortality. The main causes of neonatal deaths are prematurity and low birth weight (LBW). Gestational age(GA) estimation plays a vital role in obstetric, perinatal and neonatal care. Foot length (FL) measurement can serve as a simple, easy and cost effective parameter for estimating GA. The aim of this study was to assess newborn foot length and determine its usefulness in identifying LBW/Preterm Babies.

Methods: This is a cross sectional hospital based study of 100 newborn babies, done in Adesh Medical College and Hospital, Shahbad, Haryana. All live newborns of different gestational age within 72 hours of birth were included.

Exclusion criterias: Babies with skeletal deformities of foot.

Results: Out of 100 newborn, 54 babies were male (54%) and 46 were female (46%).Outofwhich71(71%)weretermand 29(29%)werepreterm,20(20%)were SGA, 80(80%) were AGA.Their gestational age ranged from 30 to 40 weeks.In this study,oncorrelationofgestationalageandfoot length,showedpositivecorrelationamongpreterm (r=0.328, p=0.006), term (r=0.642,p=0.031), SGA (r=0.261, p=0.015), AGA (r=0.271, p=0.008)There was significant correlation between foot length and gestational age by New Ballard Score with correlation coefficient of 0.243 (p value <0.001).

Conclusions: Foot length had a high sensitivity and specificity in identifying preterm newborns, making it a reliable tool to identify preterm birth in a rural setting.Our study has shown a good correlation of foot length with gestational maturity and birth weight. Foot lengthwasfoundtobestronglycorrelatingwithGA assessment by new Ballard score. Foot length of 7.04 cm can be used as a cut-off point for differentiating between term and preterm babies.

Key words: Foot length, gestational age, low birth weight, newborn

INTRODUCTION

Millennium development goals factor aims to reduce under five mortality by 2/3rdbetween1990-2015. It means reducing under five mortality to 36 per 1000 live births and the infant mortality rate to 27 per 1000 live births. Today, even though there are encouraging signs, India's IMR remains high at 58 per 1000 live births. The most challenging part of infant mortalityis the large proportion of newborn deaths, which contributes to 64% of all infant daeths, which are mostly in the first week of life. Major causes of neonatal mortality are diseases associated with preterm birth, low birth weight babies and major congenital anomalies[1].Thus, birth weight is single most important criteria for determining survival, growth and overall development of child. It is associated with socio-economic, hereditary, personal and geographical factors. Low birth weight is associated with high neonatal morbidity and mortality due to high predilection to infections, susceptibility to adverse environmental influences, and difficulties in maintaining adequate nutrition[2].Low birth weight is also associated with post-neonatal mortality and infant and childhood morbidity. Low birth weight accounts for about 70% ofall perinatal and 50% of all infant deaths in India. Neonates should be classified by

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gestational age (GA) as this is more meaningful than that based on birth weight. Small for gestational (SGA) infants are at higher risk for poor postnatal growth. Some adults who were SGA at birth appear to have a higher risk of coronary heart disease and related health problems, including hypertension, non-insulin dependent diabetes and stroke. Birth weight and gestational age have always been used as strong indicators to determine the risk of neonatal mortality and morbidity. Lower birth weight and short gestational period are associated with higher neonatal mortality.These factors underline the importance of early identification of LBW and preterm babies at rural setup where no medical care facilities are available and early references to higher centers. But the situation is made worse due to non-availability of resources, inexperienced birth attendants and lack of basic facilities[3-5].

Hence, there is need for an alternative measurement which can predict gestational age and birth weight. A number of studies have been done for finding suitable substitute measurents for gestational assessment and birth weight estimation. This study is being conducted to find a correlation between foot length, gestational age and other anthropometric measurements.

Aims and objectives of thestudy to findthe correlation of foot length and gestational age among the neonates. It was also aimed to study the correlation between foot length and other varaibles (gestational age, birth weight, head circumference and crown heel length) among the newborns and to assess if foot length can be used as a proxy measurement to gestational age and birth weight assessment.

MATERIALS AND METHODOLOGY

Study sample of 100 live newborns born at AdeshMedical College and Hospital Mohri, Kurukshetra were selected by simple random sampling technique.

INCLUSION CRITERIA: Live newborns of different gestational age within 72 hours of birth. Exclusion Criterias: babies with skeletal deformities of foot.Instruments used for various measurements were-

1) Sliding vernier calipers for measuring foot length.
2) Flexible, non-stretchable measuring tape for head circumference.
3) Infantometer for measuring crown heel length.
4) Electronic weighing scale for measuring weight.

Standard proforma was used for collectingdata. Gestational age assessment was done using new Ballard's score. Foot length was measured using sliding vernier caliper. After the ventral surface of foot straightened by using gentle pressure, foot length was measured from posterior most prominence of foot to the tip of great toe of right foot and documented in centimeter. Head circumference was measured using flexible and non-stretchable measuring tape. Crown heel length was measured using infantometer anddocumented in centimeters. Weight of the babywas measured using electronic weighing scale. All the dress of baby has been removed before weighing.

Babies were grouped into preterm(<37 weeks), term(37 to <42weeks) and post term(>/-42weeks) categories. All the three group of babies categoried into SGA, AGA, & LGA groups by using fentons growth chart. The data was analysed using SPSS for windows (version 20.0) software. The correlation between foot length and other parameters such as gestational age, birthweight, head circumference and crown heel length was analyzed by applying correlation and regression analysis. Correlation coefficient (r) values to be derived. Scatter diagram plotted to demonstrate the correlation between foot length and other anthropometric parameters.

RESULTS

A total of **100** newborns were included in this study. Out of 100 newborn, 54 babies were male (54%) and 46 were female(46%).Outofwhich71(71%)weretermand 29(29%)werepreterm,20(20%)wereSGA,80(80%)wereAGA.(Table 1)Their gestational age ranged from 30 to 40 weeks.

Table 1: Baseline Characteristics of Subjects

Baseline Characteristics of Subjects		
Number	**Percentage**	
Male	54	54%
Female	46	46%
Term	71	71%
Preterm	29	29%
AGA	80	80%
SGA	20	20%

There were significant correlation between foot length and different parameters like gestational age by new Ballards score, birth weight, crown heel length, head circumference and gestational age (table 2, table 3).

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Table2: Descriptive Statistics

Descriptive Statistics						
	New Ballard's Score (weeks)	Maximum Foot Length (cm)	Gestational Age (weeks)	Head Circumference (cm)	Birth Weight (kg)	Crown Heel Length (cm)
Mode	35	6.8	36	33	2.69	48
Median	35	6.9	37	33	2.603	48
Mean	33.07	6.92	36.853	33.057	2.605	47.859
Std. Deviation	3.945	0.476	1.576	1.42	0.473	2.213
IQR	6	0.4	2	2	0.651	2
Minimum	23	5.9	33	30	1.445	41
Maximum	40	8	40	36	3.7	52

Table 3: Pearson's Correlation between foot length and different parameters

Pearson's Correlations		
Variable		Maximum Foot Length (cm)
New Ballard's Score (weeks)	Pearson's r	0.243
p-value		<0.001
Birth Weight (kg)	Pearson's r	0.594
p-value		<.001
Crown Heel Length (cm)	Pearson's r	0.565
p-value		< .001
Head Circumference (cm)	Pearson's r	0.353
p-value		< .001
Gestational Age (weeks)	Pearson's r	0.37
p-value		< .001

There was significant correlation between foot length and gestational age by New Ballard Score with correlation coefficient of 0.243 (p value <0.001).

Table 4. Correlation between gestational age by New Ballard's Score and foot length

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
New Ballard's Score (weeks)	33.07	3.945	23	40	0.243	<0.001
Maximum Foot Length (cm)	6.92	0.476	5.9	8		

Betweenfootlengthandbirthweightoncorrelation analysis, we found a positive correlation with 'r' value of 0.594 (p<0.001) (table 4).

Table 5: Correlation between birth weight and foot length

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
Birth Weight (kg)	2.605	0.473	1.445	3.7	0.594	< .001
Maximum Foot Length (cm)	6.92	0.476	5.9	8		

Correlationofgestationalageandfootlengthin preterm, SGA, AGA babies In this study,oncorrelationofgestationalageandfoot length,showedpositivecorrelationamongpreterm term, (r=0.328, p=0.006), term (r=0.642,p=0.031), SGA (r=0.261, p=0.015), AGA (r=0.271, p=0.008)(Table-,6,7,8,9).

Table 6: Correlation between gestational age by New Ballard's Score and foot length in preterm babies

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
New Ballard's Score (weeks)	30.379	4.678	23	37	0.328	0.006
Maximum Foot Length (cm)	6.641		0.435	5.9	7.6	

Table 7: Correlation between gestational age by New Ballard's Score and foot length in term babies

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
New Ballard's Score (weeks)	34.169	3.005	28	40	0.642	0.031
Maximum Foot Length (cm)	7.034	0.447	6.1	8		

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Table 8: Correlation between gestational age by New Ballard's Score and foot length in SGA babies

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
New Ballard's Score (weeks)	31.5	3.426	25	37	0.261	0.015
Maximum Foot Length (cm)	6.78	0.427	6.1	7.6		

Table 9. Correlation between gestational age by New Ballard's Score and foot length in AGA babies

	Mean	SD	Minimum	Maximum	Correlation Coefficient	p Value
New Ballard's Score (weeks)	33.462	3.987	23	40	0.271	0.008
Maximum Foot Length (cm)	6.955	0.484	5.9	8		

DISCUSSION

It is important to know an infant's gestational age because its behaviour and anticipated problems can be predicted on this basis. Early identification of gestational age is important as preterm newborns require special treatment as compared to full term newborns.

In this study out of 100 newborn, 54 babies were male (54%) and 46 were female(46%) which was similar to study conducted by Srinivasa S *et al*.[7]

71(71%)weretermand 29(29%)werepreterm which was similarto James *et al*.,term (76.5%),preterm (39.6%)[8].Shahbu Saran *et al*., showed preterm(15.5%), term (76.4%) and Gohli *et al*., shown term(89.5%) and preterm (10.4%)[9, 10].These studies had lesser number ofpreterm babies as compared tothe present study. These differences may be due to poor maternal nutrition, poverty and geographical factors.

In a study done by Huque Fazhul *et al.* in 217 newborns, 2.679 kg was the mean birth weight which is comparable to present study[2].The study done by Hossain MM *et al*.9 in 148 newborns, the mean birth weight was 3.5 kg[8].

This study showed mean head circumference for term neonates as 33.07 cm which is comparable to study done by Gohil *et al*.[10] The present study shows that as the gestational age increases, head circumference also increases.

In a study done by SrivasatavaA *et al*., gestational age was found between 27 to 42 weeks[11].In this study gestational age ranges from 27 to 40 weeks which is comparable to above study.

CONCLUSION

Foot length had a high sensitivity and specificity in identifying preterm newborns, making it a reliable tool to identify preterm birth in a rural setting. In our study there is strong corelation between foot length and gestational age with correlation coefficient r=0.594. This study correlating foot length and gestational age has the potential to help neonatal care providers make informed management decisions, particularly in resource-limited settings.

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